

Amendments to the Claims

Claims 23-25, 29, 30, 32-34 and 44-47 are pending in this application. Claims 23 and 45 are amended. Claims 1-22, 26-28, 31 and 35-43 are canceled.

The Examiner has rejected claims 23-25, 29, 30, 32-34 and 44-47.

Previous Rejections

Previously, the claims were amended to include only certain photoinitiators (camphorquinone or 2,2-dimethoxy-2-phenylacetophenone) in the photopolymerizable thiol-ene compositions. Claims were also amended to comprise certain functional limitations wherein the material cures without oxygen inhibition and wherein the flexural strength is greater than 100 MPa. As a result, the Examiner has withdrawn one rejection and maintained others.

In the Non-Final Office Action mailed March 22, 2010, the Examiner has withdrawn the rejection of claims as being obvious over the disclosure of Jochum et al. alone. The Examiner maintains the rejection of the claims under 35 U.S.C. §103(a) as unpatentable as obvious over Jochum (US 5,100,929) in view of Rheinberger et al. (US 5,889,132). Also, the claims have now been rejected as obvious under 35 U.S.C. §103(a) over Rheinberger. The Examiner has fully considered but not found fully persuasive, Applicant's arguments filed March 2, 2010.

Claim Rejections - 35 USC § 112

Claims 23-25, 29, 30, 32-34 and 44-47 have been rejected under 35 U.S.C. §112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The Examiner points out that the phrase "an initiator selected from camphorquinone and 2,2-dimethoxy-2-phenyl acetophenone" is improper Markush language. The phrase should read "an initiator selected from camphorquinone or 2,2-dimethoxy-2-phenyl acetophenone" or should read "an initiator selected from the group consisting of camphorquinone and 2,2-dimethoxy-2-phenyl acetophenone".

Claim 23 has been amended to address the Examiner's concerns.

Claim Rejections - 35 USC § 102/35 USC § 103

Claims 23-25, 29, 30, 32-34 and 44-47 have been rejected under 35 U.S.C. §103(a) as allegedly obvious over Rheinberger et al. (5,889,132).

According to the Examiner, Rheinberger et al. disclose thiol-ene dental compositions and photoinitiators therefor, including camphorquinone and 2,2-dimethoxy-2-phenylacetophenone (col. 27, line 32, to col. 28, line 30; and col. 28, lines 39-50), and fillers (column 28, lines 58-65).

The Examiner continues that Rheinberger et al. teach that the disclosed compositions show only slight polymerization shrinkage and produce polymerizates with high mechanical strength (Abstract, column 2, lines 31-34, and column 28, lines 26-30).

With respect to claim 23, the Examiner states Example 11 discloses a flexural strength of 89 MPa, which is lower than the instantly claimed 100 MPa. The Examiner states Rheinberger et al. do not specifically discuss oxygen inhibition of cure.

With respect to claim 29, the Examiner states Example 11 discloses a polymerization shrinkage of 0.9 volume %. The change in volume was determined in Example 7 to be 0.5%.

With respect to claim 30, the Examiner states Rheinberger et al. do not disclose the average weight loss, when dried, of the thiol-ene polymer.

With respect to claims 32-33, the Examiner states Rheinberger et al. do not disclose the specific shrinkage stress of the polymerized material.

The Examiner further states that Rheinberger et al. teach that the disclosed compositions show only slight polymerization shrinkage and produce polymerizates with high mechanical strength in the Abstract, column 2, lines 31-34, and column 28, lines 26-30.

The Examiner further alleges that it would have been obvious to one skilled in the art at the time of the invention to determine the weight percents of the disclosed thiol-ene and filler components required to obtain a desired polymerization shrinkage or mechanical strength from the disclosure of Rheinberger et al.

According to the Examiner, there is no comparative data of record to show that unexpected results are obtained for the instantly claimed compositions compared with compositions taught by Rheinberger et al. The Examiner notes that the composition disclosed in applicant's Example consists of "TATATO" and "PETMP" and camphorquinone and that Rheinberger et al. also employ "PETMP" but do not disclose "TATATO" as a mercapto compound for the disclosed compositions.

With respect to claims 45-46, the Examiner argues it would have been obvious to one skilled in the art at the time of the invention to employ an amine reducing agent with a camphorquinone initiator. The reason given is that Rheinberger et al. teach that the α -diketones, such as camphorquinone, are preferably used with an amine reducing agent.

The Applicants respectfully traverse the rejection.

Rheinberger et al. disclose a dental material which is characterized by a content of silicic acid condensates of norbornene silanes or mercapto silanes, and which, after thiol-ene polymerisation with suitable reactants, shows only slight polymerisation shrinkage and produces polymerisates with high mechanical strength. (Abstract)

Rheinberger et al. teach that "only soft materials with elastic or viscoelastic properties can be obtained with the conventional thiol-ene systems" (Col. 2, ln 16-29).

Rheinburger et al. discloses

It is the object of the invention to make available a dental material which can be polymerised, in particular using thiol-ene polymerisation, to give composite materials having high mechanical strength and hardness, with the occurrence of only a small polymerisation shrinkage.

This object is achieved by dental material according to claims 1 to 15.

(Col 2, ln 30-37).

Rheinburger et al. claim 1 is to a dental material which comprises: (a) at least one silicic acid condensate of a hydrolysable and polymerisable norbornene silane... or (b) at least one silicic acid condensate of a hydrolysable and polymerisable mercaptosilane... The Rheinburger

claims 2-14 are each ultimately dependent upon claim 1. Thus Rheinburger et al. teaches the mechanical properties are imparted by the silicic acid condensate presence in the thiol-ene polymerisation. Further, Rheinburger makes distinct the silicic acid condensates and the reactants for thiol-ene polymerization:

- A particularly preferred dental material according to the invention contains
- (a) 5 to 80, in particular 10 to 60 wt. %, of silicic acid condensate of the norbornene silane (Ia) or the mercaptosilane (Ib), and
 - (b) 0 to 50, in particular 0 to 30 wt. %, of further hydrolytically condensable compounds, optionally in the form of condensates,
 - (c) 5 to 80, in particular 20-70 wt. %, of reactants for thiol-ene polymerisation,
 - (d) 0.1 to 5, in particular 0.2. to 2 wt. %, of polymerisation initiators, and/or
 - (e) 0 to 90 wt. %, in particular 0 to 80 wt. %, of fillers.

(Col. 28, ln 66 to Col. 29, ln 11).

The instant independent claim 23 has been amended to claim a photopolymerizable dental material consisting essentially of filler, thiol monomers, vinyl monomers; a photoinitiator and an optional amine accelerator. No silicic acid condensates of norbornene silanes or mercapto silanes are present in the claimed materials.

Further, it is a surprising result that the claimed materials exhibit a flexural strength of greater than 100 Mega Pascals after polymerization, as shown in Table 1, and paragraph 52, for the PETMP/TATATO/Filler system. Recall that Rheinburger et al. teach that "only soft materials with elastic or viscoelastic properties can be obtained with the conventional thiol-ene systems" (Col. 2, ln 16-29) (in other words, thiol-ene systems without silicic acid condensates).

In light of the amendments and arguments, reconsideration of the rejection is respectfully requested.

Claims 23, 24, 25, 29, 30, 32-34 and 44-47 have been rejected under 35 U.S.C. § 103(a) as obvious over Jochum et al. (5,100,929) in view of Rheinberger et al. (5,889,132).

The Examiner states that Jochum et al. disclose dental compositions comprising thiol-enes and a photo initiator and filler (column 2, line 33, to column 3, line 19). Jochum et al. teach that compositions containing at least 10% by weight polythiol compound, at least 10 % by

weight poly-ene compound and an acylphosphine compound as photo initiator provide a cured product free of a smeary layer. Jochum et al. teach that camphorquinone and acyl phosphine oxides are known as initiators responsive to visible light that when used in combination with tertiary amines produce a pronounced layer of smear in UV curing compositions and that this disadvantage is overcome by the disclosed thiol-ene compositions comprising an acylphosphine oxide (column 2, lines 9-26). Fillers are taught from column 6, line 64, to column 7, line 15. Jochum et al. teach that camphorquinone and acyl phosphine oxides are known as initiators responsive to visible light for polymerizing dental compositions. Jochum et al. do not disclose using 2,2-dimethoxy-2-phenyl acetophenone as initiator.

The Examiner further states that Rheinberger et al. disclose thiol-ene dental compositions and photoinitiators therefor, including camphorquinone, acyl phosphine oxides and 2,2-dimethoxy-2-phenylacetophenone (column 28, lines 39-50). With respect to claims 45-46, Rheinberger et al. teach that the α -diketones, such as camphorquinone, are preferably used with an amine reducing agent (column 28, lines 39-50, and Examples 7 and 11).

According to the Examiner, it would have been obvious to one skilled in the art at the time of the invention to substitute camphorquinone or 2,2-dimethoxy-2-phenylacetophenone for the acyl phosphine oxide photoinitiator in the compositions disclosed by Jochum et al. Jochum et al. provide motivation by teaching that camphorquinone, as well as acylphosphine oxides, is well known for visible initiation of polymerization of dental compositions as discussed above. Rheinberger et al. specifically teach that camphorquinone, 2,2-dimethoxy-2-phenylacetophenone or acylphosphine oxides are suitable photoinitiators for thiol-ene dental compositions. The Examiner further alleges that one skilled in the art at the time of the invention would have been motivated by a reasonable expectation of successfully photoinitiating polymerization of the thiol-ene dental compositions taught by Jochum et al. using camphorquinone or 2,2-dimethoxy-2-phenylacetophenone as photoinitiator, as taught by Rheinberger et al. in analogous dental compositions.

The Examiner asserts that one skilled in the art at the time of the invention would have been motivated by a reasonable expectation of curing the composition although possibly producing a smear layer as taught by Jochum et al. (emphasis added by Applicants).

The Applicants respectfully traverse the rejection.

Jochum et al. teach photopolymerizable compositions curable with visible light with (a) a poly-thiol compound, (b) a poly-ene compound, and (c) an acylphosphine oxide photoinitiator (Abstract; Col. 2, lns 33-58). Jochum et al. specifically address the problem of curing with visible light with avoidance of a smeary layer. (Col. 1, ln 48-Col. 2, ln 26).

Jochum et al. disclose "To avoid the smeary layer caused by oxygen inhibition in photopolymerizable compositions a whole series of counter measures have already been proposed" including a protective gas atmosphere, high initiator concentrations or "oxygen interceptors", such as tertiary amines. (Col 1, ln 48-60). Moreover, the increase in photoinitiator concentration on further irradiation, for example, by sunlight, causes increased discoloration and destruction of the polymer matrix by photodegradation. (Col. 2, lns 3-8)

Jochum et al. teach that prior art attempts to eliminate smear due to oxygen inhibition were unsuccessful:

So far, all the attempts to transfer the steps described above contributing to a reduction of the smeary layer in UV-curing compositions to the field of compositions which can be cured with visible light (>400 nm) were unsuccessful. For instance, with combinations of photoinitiators responsive to visible light, for example campher quinone and acyl phosphine oxides, with tertiary amines photopolymerizable compositions are obtained which, although they can be cured with visible light, after the curing due to oxygen inhibition have a pronounced layer of smear (cf. DE-A-3,443,221).

(Col. 2, ln 13-19).

Jochum et al. solve the problem to provide

"Photopolymerizable dental compositions ... which are curable with visible light ... to obtain a curing free from any smeary layer, [and] contain at least 10% by weight poly-thiol compound(s), at least 10% by weight poly-ene compound(s) and 0.01 to 5% by weight of at least one acyl phosphine compound as photoinitiator."

(emphasis added, Abstract).

For example, the Jochum et al. examples 1 and 2, cited in the action at page 3, utilize 0.5 parts by weight of 2,4,6-trimethylbenzoyl diphenyl phosphine oxide and 0.68 parts by weight of bis-(2,6-dichlorobenzoyl)-4-N-propyl-phenyl phosphine oxide, respectively, with a visible light

>400 nm. (Col. 7-8). The Jochum examples 1 and 2 result in surface hardness of 200 MPa and 250 MPa, respectively, as cited by the Examiner in the action at page 3.

In summary, Jochum et al. teach visible light thiol-ene photopolymerizable compositions where the type and amount of photoinitiator are very important to the properties of the polymerized material. Jochum et al. teach that previous methods of visible light photoinitiation in poly-ene materials results in less than desirable properties, including particularly smear caused by oxygen inhibition. Jochum et al. solves the problem of oxygen inhibition by use of a visible light photoinitiator 0.01-5% of at least one acyl phosphine compound in thiol-ene systems. (Col 2, ln 48-50).

The instant amended claim 23 claims a photopolymerizable dental restorative material consisting essentially of: particles of filler; first monomers having thiol functional groups; second monomers having vinyl functional groups; an initiator selected from camphorquinone or 2,2-dimethoxy-2-phenylacetophenone; and an optional amine accelerator wherein at least about 10% of the functional groups in the dental restorative material are thiol functional groups; and wherein the material does not contain an additional initiator; and wherein, upon exposure to light, the material cures without oxygen inhibition; and wherein after polymerization the material exhibits a flexural strength of greater than 100 Mega Pascals.

As noted above, use of camphorquinone as a photoinitiator was discouraged by Jochum et al. as being undesirable since systems containing camphorquinone "although they can be cured with visible light, after the curing due to oxygen inhibition have a pronounced layer of smear". Claim 23 specifically excludes use of other photoinitiators except for the UV initiator 2,2-dimethoxy-2-phenylacetophenone which is not taught by Jochum et al.

Therefore, with respect to Jochum et al., it is a surprising result that the material of claim 23 can be cured without oxygen inhibition since there is no acyl phosphine compound as photoinitiator.

The Jochum et al. examples 1 and 2 result in surface hardness of 200 MPa and 250 MPa, respectively, as cited by the Examiner in the action at page 3. The Examiner is respectfully reminded that surface hardness is not flexural strength. Surface hardness is the resistance of a

material against penetration by a foreign body. Surface hardness can be measured, for example, by a Vickers Instrument, Brinell Instrument, Shore Instrument, or Leeb Instrument. Jochum et al. does not provide any protocol for the surface hardness determination in examples 1 and 2; however, a reference to Shore-A hardness is provided in example 3 where a "Shore-A hardness in the range of 50-60 is ideal for use as a dental impression composition..." (Col. 8, ln 64-66). Surface hardness is not addressed in the instant specification. Rather, flexural strength is an element of claim 23 wherein the material exhibits a flexural strength of greater than 100 Mega Pascals. Flexural strength describes the amount of force required to bend and break a material when a specific thickness test piece is bent. The protocol for flexural strength is found in instant paragraph 51. A particular teaching of surface hardness does not render obvious a teaching of flexural strength; particularly for different materials.

Jochum et al. does not render obvious the material of claim 23, nor claims dependent thereupon, for the reasons discussed above: different photoinitiator systems; different range of wavelengths utilized for the photoinitiation, different mechanical properties of the cured materials, and surprising results regarding lack of oxygen inhibition without use of an acyl phosphine photoinitiator.

The deficiencies of Jochum et al. are not rendered obvious by Rheinburger et al. Rheinburger et al. teaches a different thiol-ene system that requires a content of silicic acid condensates of norbornene silanes or mercapto silanes, in order to produce polymerisates with high mechanical strength. Rheinburger teaches that only soft materials with elastic or viscoelastic properties can be obtained with the conventional thiol-ene systems. The material of claim 23 surprisingly exhibits a flexural strength of greater than 100 Mega Pascals without a content of silicic acid condensates of norbornene silanes or mercapto silanes.

Rheinburger et al. does not render obvious the material of claim 23, nor claims dependent thereupon, since there are no silicic acid condensates of norbornene silanes or mercapto silanes are present in the claimed materials; yet surprisingly the claimed materials exhibit a flexural strength of greater than 100 Mega Pascals after polymerization.

Jochum et al, in view of Rheinburger et al. neither renders the claimed materials obvious, nor even obvious to try, since smear due to oxygen inhibition is likely using a visible light

initiated thiol-ene system without a phosphine oxide photoinitiator, and since a thiol-ene system without addition of silicic acid condensates of norbornene silanes or mercapto silanes, results in only soft materials with elastic or viscoelastic properties as discussed above.

The Examiner is respectfully requested to reconsider the rejection in light of the amendments and arguments above.

It is believed that the amendments place the claims in condition for allowance. The foregoing amendments are made solely to expedite prosecution of the application and are not intended to limit the scope of the invention. Further, the amendments to the claims are made without prejudice to the pending or now canceled claims or to any subject matter pursued in a related application. Applicants reserve the right to prosecute any canceled subject matter at a later time or in a later filed divisional, continuation, or continuation-in-part application.

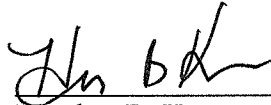
This Amendment fully responds to the Non-Final Office Action mailed on March 22, 2010. Still, the Office Action may contain arguments and rejections that are not directly addressed by this Amendment because they are rendered moot in light of the preceding amendments or the preceding arguments in favor of patentability. Hence, failure of this Amendment to directly address an argument raised in the Office Action should not be taken as an indication or admission that the Applicants believe the argument has merit. Furthermore, the claims of the present application may include other elements, not discussed in this Amendment, which are not shown, taught, or otherwise suggested by the art of record. Accordingly, the preceding arguments in favor of patentability are advanced without prejudice to other bases of patentability.

Applicants respectfully submit that the present application is in condition for allowance and solicit a notice to the effect. If the Examiner believes a telephone conference would advance the prosecution of this application, the Examiner is invited to telephone the undersigned at the below-listed telephone number.

This constitutes a petition for an extension of time if one is not specifically requested. Payment of appropriate fees by credit card accompanies this filing; however, if any additional fees are due, the Director is authorized to deduct said fees from Deposit Account # 13-2725.

Respectfully submitted,

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